Supporting Information

Regioselective Synthesis of Dihydropyridocoumarin and Phenanthroline Derivatives via Iron(III) Chloride Mediated Intramolecular Cyclization

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General information

Silica gel [Rankem (India), 60-120 mesh or 230-400 mesh] was used for chromatographic separation. Silica gel-G [CDH (India)] was used for TLC. Petroleum-ether (PE) refers to the fraction boiling between 60-80 °C. Melting points were determined in open capillaries using a metal bath apparatus [Sunbeam (India)] and are uncorrected. IR spectra were run as KBr discs on a Perkin-Elmer 120-000A apparatus. ¹H and ¹³C NMR spectra were recorded on a Bruker DPX-400 instrument as solution in CDCl₃ with TMS as internal standard. Mass spectra were recorded on a Qtof Micro instrument. CHN analyses were obtained using a Perkin Elmer 2400 series II CHN analyzer.

Experimental section

N-(3-(4-ethoxyphenyl)prop-2-ynyl)-4-methyl-N-(2-oxo-2H-chromen-6-yl)benzenesulfonamide: (7a)

Slight grey colored solid, mp 144-146 °C, Yield = 86 %, IR (KBr): 1569, 1732, 2238, 2922 cm⁻¹. ¹H NMR (400 MHz, CDCl₃): δH = 1.41 (t, J = 7.2 Hz, 3H), 2.39 (s, 3H), 4.02 (q, J = 7.2 Hz, 2H), 4.70 (s, 2H), 6.46 (d, J = 9.6 Hz, 1H), 6.79 (d, J = 8.8 Hz, 2H), 7.10 (d, J = 8.8 Hz, 2H), 7.22 (d, J = 8.0 Hz, 1H), 7.25-7.27 (m, 2H), 7.41 (dd, J = 2.4 Hz, 8.8 Hz, 1H), 7.55-7.61 (m, 3H), 7.65 (d, J = 9.6 Hz, 1H). ¹³C NMR (100 MHz, CDCl₃): δC = 14.7, 21.6, 42.1, 63.6, 81.5, 86.3, 113.8, 114.4, 117.3, 117.5, 119.1, 128.1, 128.4, 129.5, 131.5, 132.9, 135.4, 136.0, 143.0, 144.0, 153.2, 159.3, 160.3. MS: m/z = 474.00 [M+H]+ (100 %). Anal. Calcd. for C₂₇H₂₃NO₅S: C, 68.48; H, 4.90; N, 2.96 %; found C, 68.30; H, 4.95; N, 3.00 %.

N-(3-(2-ethoxyphenyl)prop-2-ynyl)-4-methyl-N-(2-oxo-2H-chromen-6-yl)benzenesulfonamide: (7b)

Slight grey colored solid, mp 142-144 °C, Yield = 83 %, IR (KBr): 1596, 1733, 2242, 2978 cm⁻¹. ¹H NMR (400 MHz, CDCl₃): δH = 1.25-1.33 (m, 3H), 2.32 (s, 3H), 4.00 (q, J = 6.8 Hz, 2H), 4.72 (s, 2H), 6.45 (d, J = 9.6 Hz, 1H), 6.84 (q, J = 8.0 Hz, 2H), 7.10-7.15 (m, 3H), 7.23-7.27 (m, 2H), 7.52-7.67 (m, 5H). ¹³C NMR (100 MHz, CDCl₃): δC = 14.7, 21.5, 42.3, 64.0, 83.0, 86.7, 111.5, 111.7, 117.2, 117.4, 119.0, 120.2, 128.1, 128.5, 129.4, 130.1, 131.4, 133.5, 135.3, 136.1, 143.1, 143.9, 153.2, 159.5, 160.3. MS: m/z = 474.00 [M+H]+ (100 %). Anal. Calcd. for C₂₇H₂₃NO₅S: C, 68.48; H, 4.90; N, 2.96 %; found C, 68.27; H, 4.94; N, 3.02 %.
N-(3-(4-isopropoxyphenyl)prop-2-ynyl)-4-methyl-N-(2-oxo-2H-chromen-6-yl)benzenesulfonamide: (7c)

Slight grey colored solid, mp 120-122 °C, Yield = 87 %, IR (KBr): 1594, 1730, 2240, 2972 cm\(^{-1}\).
\(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta_H = 1.33\) (d, \(J = 6.0\) Hz, 6H), 2.38 (s, 3H), 4.53 (m, 1H), 4.65 (s, 2H), 6.45 (d, \(J = 9.6\) Hz, 1H), 6.77 (d, \(J = 8.8\) Hz, 2H), 7.09 (d, \(J = 8.8\) Hz, 2H), 7.21-7.27 (m, 3H), 7.41 (dd, \(J = 2.4\) Hz, 8.8 Hz, 1H), 7.54-7.58 (m, 3H). 7.65 (d, \(J = 9.6\) Hz, 1H). \(^13\)C NMR (100 MHz, CDCl\(_3\)): \(\delta_C = 21.6, 21.9, 42.1, 69.9, 81.4, 86.3, 113.6, 115.6, 117.3, 117.4, 119.1, 128.1, 128.4, 129.5, 131.5, 133.0, 135.3, 135.9, 143.0, 144.0, 153.2, 158.3, 160.3. MS: \(m/z = 488.12\) [M+H\(^+\)] (100 %). Anal. Calcd. for C\(_{28}\)H\(_{25}\)NO\(_5\)S: C, 68.98; H, 5.17; N, 2.87 %; found C, 68.87; H, 5.14; N, 2.94 %.

N-(3-(2-methoxyphenyl)prop-2-ynyl)-4-methyl-N-(2-oxo-2H-chromen-6-yl)benzenesulfonamide: (7d)

Slight grey colored solid, mp 142-144 °C, Yield = 91 %, IR (KBr): 1696, 1732, 2236, 2923 cm\(^{-1}\).
\(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta_H = 2.33\) (s, 3H), 3.75 (s, 3H), 4.72 (s, 2H), 6.44 (d, \(J = 9.2\) Hz, 1H), 6.85 (q, \(J = 8.0\) Hz, 2H), 7.10 (d, \(J = 7.2\) Hz, 1H), 7.16 (d, \(J = 7.6\) Hz, 2H), 7.28 (q, \(J = 7.2\) Hz, 2H), 7.53-7.65 (m, 5H). \(^13\)C NMR (100 MHz, CDCl\(_3\)): \(\delta_C = 21.5, 42.3, 55.6, 82.9, 87.0, 110.5, 111.2, 117.2, 117.3, 119.0, 120.4, 128.1, 128.5, 129.4, 130.2, 131.8, 133.2, 135.3, 136.0, 143.1, 143.9, 153.2, 160.1, 160.3. MS: \(m/z = 460.07\) [M+H\(^+\)] (100 %). Anal. Calcd. for C\(_{26}\)H\(_{21}\)NO\(_5\)S: C, 67.96; H, 4.61; N, 3.05 %; found C, 68.07; H, 4.66; N, 3.08 %.

N-(3-(4-(benzyloxy)phenyl)prop-2-ynyl)-4-methyl-N-(2-oxo-2H-chromen-6-yl)benzenesulfonamide: (7e)

Slight grey colored solid, mp 134-136 °C, Yield = 82 %, IR (KBr): 1693, 1732, 2228, 2991 cm\(^{-1}\).
\(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta_H = 2.38\) (s, 3H), 4.65 (s, 2H), 5.06 (s, 2H), 6.46 (d, \(J = 9.2\) Hz, 1H), 6.87 (d, \(J = 8.8\) Hz, 2H), 7.11 (d, \(J = 8.8\) Hz, 2H), 7.22 (d, \(J = 7.6\) Hz, 2H), 7.25-7.27 (m, 2H), 7.34-7.40 (m, 5H), 7.55-7.58 (m, 3H), 7.65 (d, \(J = 9.6\) Hz, 1H). \(^13\)C NMR (100 MHz, CDCl\(_3\)): \(\delta_C = 21.6, 42.1, 70.0, 81.7, 86.1, 114.3, 114.8, 117.3, 117.5, 119.1, 127.4, 128.1, 128.2, 128.4, 128.7, 129.5, 131.4, 133.0, 135.4, 135.9, 136.4, 143.0, 144.0, 153.2, 159.0, 160.3. MS: \(m/z = 536.11\) [M+H\(^+\)] (100 %). Anal. Calcd. for C\(_{32}\)H\(_{25}\)NO\(_5\)S: C, 71.76; H, 4.70; N, 2.62 %; found C, 71.90; H, 4.75; N, 2.70 %.
N-(3-(4-(allyloxy)phenyl)prop-2-ynyl)-4-methyl-N-(2-oxo-2H-chromen-6-yl)benzenesulfonamide: (7f)

Slight grey colored solid, mp 120-122 °C, Yield = 84 %, IR (KBr): 1692, 1731, 2230, 2997 cm⁻¹. ¹H NMR (400 MHz, CDCl₃): δ_H = 2.38 (s, 3H), 4.52 (dd, J = 1.2 Hz, 4.0 Hz, 2H), 4.65 (s, 2H), 5.30 (dd, J = 1.2 Hz, 10.4 Hz, 1H), 5.41 (dd, J = 1.2 Hz, 9.2 Hz, 1H), 5.98-6.05 (m, 1H), 6.45 (d, J = 9.6 Hz, 1H), 6.81 (d, J = 8.8 Hz, 2H), 7.10 (dd, J = 2.0 Hz, 9.2 Hz, 2H), 7.20-7.28 (m, 3H), 7.41 (dd, J = 2.4 Hz, 8.8 Hz, 1H), 7.54-7.58 (m, 3H), 7.66 (d, J = 9.6 Hz, 1H). ¹³C NMR (100 MHz, CDCl₃): δ_C = 21.6, 42.1, 68.8, 81.6, 86.1, 114.1, 114.7, 117.2, 117.5, 118.0, 119.1, 128.0, 128.4, 129.5, 131.5, 132.7, 132.9, 135.3, 135.9, 143.1, 144.1, 153.2, 158.9, 160.3. MS: m/z = 486.21 [M+H]+ (100 %). Anal. Calcd. for C_{28}H_{23}NO_{5}S: C, 69.26; H, 4.77; N, 2.88 %; found C, 69.10; H, 4.81; N, 2.81 %.

N-(3-(4-acetylphenyl)prop-2-ynyl)-4-methyl-N-(2-oxo-2H-chromen-6-yl)benzenesulfonamide: (7i)

Slight grey colored solid, mp 126-128 °C, Yield = 82 %, IR (KBr): 1686, 1729, 2228, 2969 cm⁻¹. ¹H NMR (400 MHz, CDCl₃): δ_H = 2.40 (s, 3H), 2.59 (s, 3H), 4.70 (s, 2H), 6.47 (d, J = 9.6 Hz, 1H), 7.23-7.28 (m, 5H), 7.39 (dd, J = 2.4 Hz, 8.8 Hz, 1H), 7.54-7.58 (m, 3H), 7.64 (d, J = 9.6 Hz, 1H), 7.87 (d, J = 8.4 Hz, 2H). ¹³C NMR (100 MHz, CDCl₃): δ_C = 21.6, 42.1, 68.8, 81.6, 86.1, 114.1, 114.7, 117.2, 117.5, 118.0, 119.1, 128.0, 128.4, 129.5, 131.5, 132.7, 132.9, 135.3, 135.9, 143.1, 144.1, 153.2, 158.9, 160.3. MS: m/z = 472.09 [M+H]+ (100 %). Anal. Calcd. for C_{27}H_{21}NO_{5}S: C, 69.26; H, 4.77; N, 2.88 %; found C, 69.10; H, 4.81; N, 2.81 %.

6-(ethyl(3-(4-methoxyphenyl)prop-2-ynyl)amino)-2H-chromen-2-one: (7j)

Yellow gummy, Yield = 91 %, IR (KBr): 1569, 1679, 1720, 2969 cm⁻¹. ¹H NMR (400 MHz, CDCl₃): δ_H = 1.26 (t, J = 7.2 Hz, 3H), 3.51 (q, J = 7.2 Hz, 2H), 3.78 (s, 3H), 4.23 (s, 2H), 6.40 (d, J = 9.6 Hz, 1H), 6.81 (d, J = 8.4 Hz, 2H), 6.88 (d, J = 2.8 Hz, 1H), 7.12 (dd, J = 2.8 Hz, 9.2 Hz, 1H), 7.24-7.39 (m, 3H), 7.67 (d, J = 9.2 Hz, 1H). ¹³C NMR (100 MHz, CDCl₃): δ_C = 12.4, 41.0, 46.1, 55.3, 83.5, 84.1, 111.2, 113.7, 113.9, 114.8, 116.7, 117.4, 119.0, 119.3, 132.3, 133.1, 143.9, 145.1, 146.8, 159.6, 161.5. MS: m/z = 334.14 [M+H]+ (100 %). Anal. Calcd. for C_{21}H_{19}NO_{3}: 75.66; H, 5.74; N, 4.20 %; found C, 75.46; H, 5.81; N, 4.29 %.
N-(3-(4-isopropoxyphenyl)prop-2-ynyl)-4-methyl-N-(1-methyl-2-oxo-1,2-dihydroquinolin-6-yl)benzenesulfonamide: (7k)

Slight grey colored solid, mp 110-112 °C, Yield = 85 %, IR (KBr): 1681, 1702, 2222, 2951 cm⁻¹. 

1H NMR (400 MHz, CDCl₃): δH = 1.33 (d, J = 6.0 Hz, 6H), 2.38 (s, 3H), 3.69 (s, 3H), 4.53 (t, J = 6.0 Hz, 1H), 4.67 (s, 2H), 6.71 (d, J = 8.8 Hz, 1H), 6.77 (d, J = 8.4 Hz, 1H), 7.09 (d, J = 8.4 Hz, 2H), 7.22 (d, J = 8.0 Hz, 2H), 7.31 (d, J = 8.8 Hz, 1H), 7.46-7.69 (m, 6H). 13C NMR (100 MHz, CDCl₃): δC = 21.6, 21.9, 29.6, 42.2, 69.9, 81.7, 86.1, 113.7, 114.8, 115.5, 120.8, 122.4, 128.1, 128.5, 128.6, 129.4, 130.8, 131.9, 132.0, 132.1, 133.0, 133.9, 135.6, 138.7, 139.5, 143.8, 158.2, 160.2. MS: m/z = 501.19 [M+H]⁺ (100 %). Anal. Calcd. for C₂₉H₂₈N₂O₄S: C, 69.58; H, 5.64; N, 5.60 %; found C, 69.77; H, 5.67; N, 5.48 %.

N-(3-(4-ethoxyphenyl)prop-2-ynyl)-4-methyl-N-(1-methyl-2-oxo-1,2-dihydroquinolin-6-yl)benzenesulfonamide: (7l)

Slight grey colored solid, mp 144-146 °C, Yield = 92 %, IR (KBr): 1646, 1702, 2220, 2991 cm⁻¹. 

1H NMR (400 MHz, CDCl₃): δH = 1.40 (t, J = 7.2 Hz, 3H), 2.38 (s, 3H), 3.69 (s, 3H), 4.02 (q, J = 6.8 Hz, 2H), 4.67 (s, 2H), 6.72 (d, J = 9.2 Hz, 1H), 6.78 (d, J = 8.4 Hz, 2H), 7.10 (d, J = 8.4 Hz, 2H), 7.22 (d, J = 8.0 Hz, 2H), 7.31 (d, J = 8.8 Hz, 1H), 7.46-7.59 (m, 5H). 13C NMR (100 MHz, CDCl₃): δC = 14.7, 21.6, 29.6, 42.2, 63.5, 81.8, 86.0, 113.9, 114.4, 114.8, 120.8, 122.4, 128.1, 128.6, 129.4, 130.8, 132.9, 133.9, 135.6, 138.7, 139.5, 143.8, 159.2, 162.2. MS: m/z = 487.24 [M+H]⁺ (100 %). Anal. Calcd. for C₂₈H₂₆N₂O₄S: C, 69.11; H, 5.39; N, 5.76 %; found C, 68.90; H, 5.44; N, 5.70 %.

N-(3-(4-ethoxyphenyl)prop-2-ynyl)-N-(1-ethyl-2-oxo-1,2-dihydroquinolin-6-yl)-4-methylbenzenesulfonamide: (7n)

Slight grey colored solid, mp 128-130 °C, Yield = 84 %, IR (KBr): 1642, 1702, 2217, 2981 cm⁻¹. 

1H NMR (400 MHz, CDCl₃): δH = 1.35 (t, J = 7.2 Hz, 3H), 1.41 (t, J = 7.2 Hz, 3H), 2.39 (s, 3H), 4.02 (t, J = 6.8 Hz, 2H), 4.34 (d, J = 7.2 Hz, 2H), 4.67 (s, 2H), 6.71 (d, J = 9.6 Hz, 1H), 6.78 (d, J = 8.8 Hz, 2H), 7.10 (d, J = 8.8 Hz, 2H), 7.22 (d, J = 8.0 Hz, 2H), 7.33 (d, J = 8.8 Hz, 1H), 7.50-7.56 (m, 3H), 7.61 (d, J = 8.4 Hz, 2H). 13C NMR (100 MHz, CDCl₃): δC = 12.7, 14.7, 21.6,
N-(1-ethyl-2-oxo-1,2-dihydroquinolin-6-yl)-4-methyl-N-(3-p-tolylprop-2-ynyl)benzenesulfonamide: (7p)

Slight grey colored solid, mp 130-132 °C, Yield = 86 %, IR (KBr): 1509, 1590, 1645, 2973 cm\(^{-1}\). \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta_H = 1.34\) (t, \(J = 7.2\) Hz, 3H), 2.33 (s, 3H), 2.38 (s, 3H), 4.33 (q, \(J = 6.8\) Hz, 2H), 4.68 (s, 2H), 6.70 (d, \(J = 9.6\) Hz, 1H), 7.06 (m, 4H), 7.22 (d, \(J = 8.0\) Hz, 2H), 7.33 (d, \(J = 8.8\) Hz, 1H), 7.50-7.56 (m, 3H), 7.61 (d, \(J = 8.0\) Hz, 2H). \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \(\delta_C = 12.8, 21.5, 21.6, 37.6, 42.3, 82.7, 86.1, 114.7, 119.0, 121.1, 122.5, 128.1, 128.9, 129.0, 129.4, 130.9, 131.3, 133.6, 135.7, 138.56, 138.65, 138.9, 143.8, 161.7. MS: m/z = 471.09 [M+H]\(^+\) (100 %). Anal. Calcd. for C\(_{28}\)H\(_{26}\)N\(_2\)O\(_3\)S: C, 71.46; H, 5.57; N, 5.95 %; found C, 71.60; H, 5.48; N, 5.90 %.

Compounds 7g, 7h and 7m, 7o, and 7q were prepared according to earlier published procedure.\(^{32}\)

**General Procedure for the synthesis of pyranoquinoline or phenanthroline derivatives:** The alkyne 7 (100 mg) was added to a well-stirred solution of FeCl\(_3\) (1 equiv.) in CH\(_3\)CN (2 mL), at room temperature and the resulting mixture was stirred at 80 °C under nitrogen atmosphere for 12 h. After completion of the reaction (monitored by TLC) the reaction mixture was cooled and extracted with dichloromethane (3 x 25 mL). The combined organic extract was washed with brine (25 mL) and dried over Na\(_2\)SO\(_4\). The solvent was removed by distillation and the resulting crude residue was purified by filtration through a pad of silica gel (230-400 mesh, PE-EtOAc) to give the pure cyclized product (9).

**9-(4-ethoxyphenyl)-7-tosyl-7,8-dihydro-3H-pyrano[3,2-f]quinolin-3-one: (9a)**

Slight yellow colored solid, mp 176-178 °C, Yield = 76 %, IR (KBr): 1510, 1609, 1734, 2970 cm\(^{-1}\). \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta_H = 1.43\) (t, \(J = 6.8\) Hz, 3H), 2.19 (s, 3H), 4.02 (q, \(J = 6.8\) Hz, 2H), 4.47 (s, 2H), 5.76 (t, \(J = 4.8\) Hz, 1H), 5.95 (d, \(J = 10.0\) Hz, 1H), 6.49 (s, 2H), 6.72 (d, \(J = 7.6\) Hz, 2H), 6.96 (t, \(J = 6.8\) Hz, 3H), 7.35 (d, \(J = 8.0\) Hz, 3H), 8.08 (d, \(J = 8.8\) Hz, 1H). \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \(\delta_C = 14.8, 21.4, 45.2, 63.5, 114.4, 114.6, 115.3, 117.2, 125.0, 127.5,
9-(2-ethoxyphenyl)-7-tosyl-7,8-dihydro-3H-pyrano[3,2-f]quinolin-3-one: (9b)

Slight yellow colored solid, mp 178-180 °C, Yield = 71 %, IR (KBr): 1575, 1732, 2980 cm⁻¹. ¹H NMR (400 MHz, CDCl₃): δH = 1.01 (t, J = 6.8 Hz, 3H), 2.21 (s, 3H), 3.72 (q, J = 7.6 Hz, 2H), 5.93 (t, J = 4.8 Hz, 2H), 6.40 (d, J = 6.8 Hz, 1H), 6.76-6.79 (m, 2H), 7.21-7.30 (m, 2H), 7.49 (d, J = 7.6 Hz, 2H), 8.06 (d, J = 9.2 Hz, 1H). ¹³C NMR (100 MHz, CDCl₃): δC = 14.4, 21.4, 45.0, 63.3, 111.8, 114.6, 115.6, 116.5, 120.6, 127.6, 127.8, 128.2, 129.2, 129.3, 129.4, 129.5, 130.2, 133.2, 133.5, 136.8, 141.0, 143.6, 152.9, 155.0, 160.1. MS: m/z = 474.00 [M+H]⁺ (100 %), 496.00 [M+Na]⁺ (66 %). Anal. Calcd. for C₂₇H₂₃NO₅S: C, 68.48; H, 4.90; N, 2.96 %; found C, 68.61; H, 4.94; N, 3.02 %.

9-(4-isopropoxyphenyl)-7-tosyl-7,8-dihydro-3H-pyrano[3,2-f]quinolin-3-one: (9c)

Slight yellow colored solid, mp 160-162 °C, Yield = 76 %, IR (KBr): 1579, 1732, 2992 cm⁻¹. ¹H NMR (400 MHz, CDCl₃): δH = 1.35 (d, J = 6.0 Hz, 6H), 2.18 (s, 3H), 4.46 (d, J = 3.6 Hz, 2H), 4.54 (p, J = 6.0 Hz, 1H), 5.76 (t, J = 4.8 Hz, 1H), 5.95 (t, J = 9.6 Hz, 1H), 6.49 (d, J = 7.2 Hz, 2H), 6.71 (d, J = 8.4 Hz, 2H), 6.95-7.00 (m, 3H), 7.32-7.35 (m, 3H), 8.08 (d, J = 8.8 Hz, 1H). ¹³C NMR (100 MHz, CDCl₃): δC = 21.3, 22.0, 45.2, 70.0, 114.5, 115.3, 115.8, 117.1, 124.9, 127.5, 128.2, 129.0, 129.3, 130.7, 131.9, 133.7, 136.1, 136.7, 141.4, 143.7, 153.6, 157.7, 159.9. MS: m/z = 488.19 [M+H]⁺ (100 %). Anal. Calcd. for C₂₈H₂₅NO₅S: C, 68.98; H, 5.17; N, 2.87 %; found C, 68.84; H, 5.15; N, 2.83 %.

9-(2-methoxyphenyl)-7-tosyl-7,8-dihydro-3H-pyrano[3,2-f]quinolin-3-one: (9d)

Slight yellow colored solid, mp 162-164 °C, Yield = 74 %, IR (KBr): 1575, 1595, 1729, 2920 cm⁻¹. ¹H NMR (400 MHz, CDCl₃): δH = 2.23 (s, 3H), 3.56 (s, 3H), 4.44 (dd, J = 4.8 Hz, 17.2 Hz, 1H), 4.62 (dd, J = 5.2 Hz, 17.2 Hz, 1H), 5.92 (t, J = 10.0 Hz, 1H), 5.97 (t, J = 4.8 Hz, 1H), 6.24 (d, J = 7.2 Hz, 1H), 6.76 (t, J = 7.2 Hz, 1H), 6.84 (d, J = 8.0 Hz, 1H), 6.96-7.02 (m, 3H), 7.23-7.29 (m, 2H), 7.45 (d, J = 7.6 Hz, 2H), 8.07 (d, J = 8.8 Hz, 1H). ¹³C NMR (100 MHz, CDCl₃): δC = 21.4, 45.1, 55.2, 111.0, 114.7, 115.3, 116.6, 120.7, 127.6, 128.0, 128.1, 128.3, 129.2, 129.3,
129.5, 130.3, 133.0, 133.05, 136.6, 140.9, 143.6, 153.1, 155.6, 160.0. MS: m/z = 460.06 [M+H]^+ (100 %). Anal. Calcd. for C_{26}H_{21}NO_{5}S: C, 67.96; H, 4.61; N, 3.05 %; found C, 67.79; H, 4.65; N, 3.11 %.

9-(4-(benzyloxy)phenyl)-7-tosyl-7,8-dihydro-3H-pyrano[3,2-f]quinolin-3-one: (9e)

Slight yellow colored solid, mp 184-186 °C, Yield = 72 %, IR (KBr): 1571, 1592, 1731, 2952 cm\(^{-1}\). \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta_H = 2.12 \,(s, \, 3H), \, 4.46 \,(s, \, 2H), \, 5.06 \,(s, \, 2H), \, 5.76 \,(s, \, 1H), \, 5.94 \,(t, \, J = 10.0 \,Hz, \, 1H), \, 6.50 \,(s, \, 2H), \, 6.75-6.80 \,(m, \, 2H), \, 6.92-6.97 \,(m, \, 3H), \, 7.21-7.42 \,(m, \, 8H), \, 8.07 \,(d, \, J = 8.8 \,Hz, \, 1H). \) \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \(\delta_C = 21.3, \, 45.2, \, 70.0, \, 114.6, \, 115.0, \, 115.3, \, 117.2, \, 125.1, \, 127.5, \, 128.2, \, 128.7, \, 128.9, \, 129.3, \, 130.7, \, 132.5, \, 133.7, \, 136.0, \, 136.5, \, 136.6, \, 141.3, \, 143.7, \, 153.6, \, 158.5, \, 159.9. \) MS: m/z = 536.08 [M+H]^+ (100 %). Anal. Calcd. for C\(_{32}\)H\(_{25}\)NO\(_{5}\)S: C, 71.76; H, 4.70; N, 2.62 %; found C, 71.98; H, 4.65; N, 2.58 %.

9-(4-(allyloxy)phenyl)-7-tosyl-7,8-dihydro-3H-pyrano[3,2-f]quinolin-3-one: (9f)

Slight yellow colored solid, mp 120-122 °C, Yield = 66 %, IR (KBr): 1508, 1567, 1724, 2919 cm\(^{-1}\). \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta_H = 2.19 \,(s, \, 3H), \, 4.47 \,(d, \, J = 4.8 \,Hz, \, 2H), \, 4.53 \,(d, \, J = 4.8 \,Hz, \, 2H), \, 5.33 \,(dd, \, J = 1.2 \,Hz, \, 10.4 \,Hz, \, 1H), \, 5.44 \,(dd, \, J = 1.2 \,Hz, \, 16.8 \,Hz, \, 1H), \, 5.77 \,(t, \, J = 4.8 \,Hz, \, 1H), \, 5.95 \,(d, \, J = 10.0 \,Hz, \, 1H), \, 6.02-6.06 \,(m, \, 1H), \, 6.50 \,(d, \, J = 7.6 \,Hz, \, 2H), \, 6.75 \,(d, \, J = 8.8 \,Hz, \, 2H), \, 6.94-6.97 \,(m, \, 3H), \, 7.30-7.35 \,(m, \, 3H), \, 8.08 \,(d, \, J = 8.8 \,Hz, \, 1H). \) \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \(\delta_C = 21.4, \, 45.2, \, 68.8, \, 114.6, \, 114.7, \, 115.3, \, 117.2, \, 118.1, \, 125.1, \, 127.4, \, 128.2, \, 129.4, \, 130.1, \, 130.7, \, 132.3, \, 132.9, \, 133.7, \, 136.0, \, 136.6, \, 141.4, \, 143.8, \, 153.6, \, 158.3, \, 160.0. \) MS: m/z = 486.09 [M+H]^+ (100 %). Anal. Calcd. for C\(_{28}\)H\(_{23}\)NO\(_{5}\)S: C, 69.26; H, 4.77; N, 2.88 %; found C, 69.40; H, 4.71; N, 2.91 %.

9-(4-isopropoxyphenyl)-4-methyl-7-tosyl-7,8-dihydro-4,7-phenanthrolin-3(4H)-one: (9g)

Slight yellow colored solid, mp 174-176 °C, Yield = 75 %, IR (KBr): 1508, 1563, 1660, 2973 cm\(^{-1}\). \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta_H = 1.34 \,(d, \, J = 6.0 \,Hz, \, 6H), \, 2.14 \,(s, \, 3H), \, 3.75 \,(s, \, 3H), \, 4.45 \,(s, \, 2H), \, 4.51 \,(p, \, J = 6.0 \,Hz, \, 1H), \, 5.75 \,(t, \, J = 5.2 \,Hz, \, 1H), \, 6.24 \,(d, \, J = 10.0 \,Hz, \, 1H), \, 6.47 \,(bs, \, 2H), \, 6.67 \,(d, \, J = 8.0 \,Hz, \, 2H), \, 7.06 \,(d, \, J = 10.0 \,Hz, \, 1H), \, 7.35 \,(d, \, J = 8.0 \,Hz, \, 2H), \, 7.43 \,(d, \, J = 9.2 \,Hz, \, 1H), \, 8.13 \,(d, \, J = 8.8 \,Hz, \, 1H). \) \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \(\delta_C = 21.3, \, 22.0, \, 29.9, \, 45.3, \, 70.0, \, 114.7, \, 115.6, \, 117.0, \, 119.8, \, 124.7, \, 127.4, \, 128.1, \, 129.0, \, 129.28, \, 129.33, \, 132.2, \, 132.5, \, 136.1,
9-(4-ethoxyphenyl)-4-methyl-7-tosyl-7,8-dihydro-4,7-phenanthrolin-3(4H)-one: (9h)

Slight yellow colored gummy solid, Yield = 69 %, IR (KBr): 1510, 1606, 1651, 2249, 2982 cm⁻¹. \( ^1H \) NMR (400 MHz, CDCl₃): \( \delta_H = 1.42 (t, J = 6.8 Hz, 3H), 2.15 (s, 3H), 3.75 (s, 3H), 4.01 (q, J = 6.8 Hz, 2H), 4.44 (d, J = 5.2 Hz, 2H), 5.76 (t, J = 5.2 Hz, 1H), 6.23 (d, J = 10.0 Hz, 1H), 6.48 (bs, 1H), 6.68 (d, J = 8.0 Hz, 2H), 6.92 (d, J = 8.0 Hz, 1H), 7.05 (d, J = 10.0 Hz, 1H), 7.35 (d, J = 8.0 Hz, 2H), 7.43 (d, J = 9.2 Hz, 1H), 7.47-7.51 (m, 1H), 7.55 (t, J = 8.0 Hz, 1H), 8.13 (d, J = 9.2 Hz, 1H). \( ^13C \) NMR (100 MHz, CDCl₃): \( \delta_C = 14.8, 21.4, 29.9, 45.3, 63.5, 114.2, 114.7, 116.9, 119.8, 124.7, 127.4, 128.1, 129.0, 129.3, 132.2, 132.7, 136.1, 137.0, 137.2, 139.8, 143.5, 158.5, 161.5. MS: m/z = 487.12 [M+H]⁺ (100 %). Anal. Calcd. for C₂₈H₂₆N₂O₄S: C, 69.11; H, 5.39; N, 5.76 %; found C, 69.28; H, 5.45; N, 5.67 %.

9-(4-methoxyphenyl)-4-methyl-7-tosyl-7,8-dihydro-4,7-phenanthrolin-3(4H)-one: (9i)

Slight yellow colored gummy solid, Yield = 63 %, IR (KBr): 1507, 1556, 1662, 2968 cm⁻¹. \( ^1H \) NMR (400 MHz, CDCl₃): \( \delta_H = 2.15 (s, 3H), 3.75 (s, 3H), 3.80 (s, 3H), 4.45 (s, 2H), 5.76 (s, 1H), 6.23 (d, J = 9.6 Hz, 1H), 6.49 (bs, 2H), 6.69 (d, J = 7.2 Hz, 2H), 6.92 (d, J = 7.2 Hz, 2H), 7.05 (d, J = 8.8 Hz, 1H), 7.35 (d, J = 7.2 Hz, 2H), 7.43 (d, J = 8.4 Hz, 1H), 8.13 (d, J = 8.4 Hz, 1H). MS: m/z = 473.19 [M+H]⁺ (100 %). Anal. Calcd. for C₂₇H₂₄N₂O₄S: C, 68.62; H, 5.12; N, 5.93 %; found C, 68.48; H, 5.15; N, 5.99 %.

9-(4-ethoxyphenyl)-4-ethyl-7-tosyl-7,8-dihydro-4,7-phenanthrolin-3(4H)-one: (9j)

Slight yellow colored gummy solid, Yield = 68 %, IR (KBr): 1510, 1552, 1660, 2973 cm⁻¹. \( ^1H \) NMR (400 MHz, CDCl₃): \( \delta_H = 1.21-1.31 (m, 3H), 1.42 (t, J = 7.2 Hz, 3H), 2.15 (s, 3H), 4.01 (d, J = 6.4 Hz, 2H), 4.38 (d, J = 6.8 Hz, 2H), 4.44 (s, 2H), 5.74 (s, 1H), 6.22 (d, J = 9.6 Hz, 1H), 6.49 (bs, 2H), 6.68 (d, J = 7.2 Hz, 2H), 6.92 (d, J = 7.2 Hz, 2H), 7.06 (d, J = 10.0 Hz, 1H), 7.34 (t, J = 7.2 Hz, 2H), 7.43 (d, J = 8.8 Hz, 1H), 8.13 (d, J = 8.8 Hz, 1H). MS: m/z = 501.09 [M+H]⁺ (100 %). Anal. Calcd. for C₂₉H₂₈N₂O₄S: C, 69.58; H, 5.64; N, 5.60 %; found C, 69.78; H, 5.69; N, 5.69 %.
\[ N-(3-(4-ethoxyphenyl)prop-2-ynyl)-4-methyl-N-(2-oxo-2H-chromen-6-yl)benzenesulfonamide: \ (7a) \]
$N$-(3-(2-ethoxyphenyl)prop-2-ynyl)-4-methyl-$N$-(2-oxo-2$H$-chromen-6-yl)benzenesulfonamide: (7b)
N-(3-(4-isopropoxyphenyl)prop-2-ynyl)-4-methyl-N-(2-oxo-2H-chromen-6-yl)benzenesulfonamide: (7c)
N-(3-(2-methoxyphenyl)prop-2-ynyl)-4-methyl-N-(2-oxo-2H-chromen-6-yl)benzenesulfonamide: (7d)
$N$-(3-(4-(benzyloxy)phenyl)prop-2-ynyl)-4-methyl-$N$-(2-oxo-$2H$-chromen-6-yl)benzenesulfonamide: (7e)
\(N-(3-(4-(allyloxy)phenyl)prop-2-ynyl)-4-methyl-N-(2-oxo-2^{H}\text{-chromen}-6-yl)benzenesulfonamide: \text{(7f)}\)
$N$-(3-(4-acetylphenyl)prop-2-ynyl)-4-methyl-$N$-(2-oxo-2$H$-chromen-6-yl)benzenesulfonamide: (7f)
6-(ethyl(3-(4-methoxyphenyl)prop-2-ynyl)amino)-2H-chromen-2-one: (7j)
$N$-(3-(4-isopropoxyphenyl)prop-2-ynyl)-4-methyl-$N$-(1-methyl-2-oxo-1,2-dihydroquinolin-6-yl)benzenesulfonamide: (7k)
$N$-(3-(4-ethoxyphenyl)prop-2-ynyl)-4-methyl-$N$-(1-methyl-2-oxo-1,2-dihydroquinolin-6-yl)benzenesulfonamide: (7l)
N-(3-(4-ethoxyphenyl)prop-2-ynyl)-N-(1-ethyl-2-oxo-1,2-dihydroquinolin-6-yl)-4-methylbenzenesulfonamide: (7n)
N-(1-ethyl-2-oxo-1,2-dihydroquinolin-6-yl)-4-methyl-N-(3-p-tolylprop-2-ynyl)benzenesulfonamide: (7p)
9-(4-ethoxyphenyl)-7-tosyl-7,8-dihydro-3H-pyrano[3,2-f]quinolin-3-one: (9a)
9-(2-ethoxyphenyl)-7-tosyl-7,8-dihydro-3H-pyrano[3,2-f]quinolin-3-one: (9b)
9-(4-isopropoxyphenyl)-7-tosyl-7,8-dihydro-3H-pyrano[3,2-f]quinolin-3-one: (9c)
9-(2-methoxyphenyl)-7-tosyl-7,8-dihydro-3$H$-pyrano[3,2-$f$]quinolin-3-one: (9d)
9-(4-(benzyloxy)phenyl)-7-tosyl-7,8-dihydro-3H-pyrano[3,2-f]quinolin-3-one: (9c)
9-(4-(allyloxy)phenyl)-7-tosyl-7,8-dihydro-3H-pyrano[3,2-f]quinolin-3-one: (9f)
9-(4-isopropoxyphenyl)-4-methyl-7-tosyl-7,8-dihydro-4,7-phenanthroline-3(4H)-one: (9g)
9-(4-ethoxyphenyl)-4-methyl-7-tosyl-7,8-dihydro-4,7-phenanthroline-3(4H)-one: (9h)
9-(4-methoxyphenyl)-4-methyl-7-tosyl-7,8-dihydro-4,7-phenanthroline-3(4H)-one: (9i)
9-(4-ethoxyphenyl)-4-ethyl-7-tosyl-7,8-dihydro-4,7-phenanthroline-3(4H)-one: (9j)